

Open Research Online

The Open University's repository of research publications and other research outputs

Improving App Quality Despite Flawed Mobile Analytics

Conference or Workshop Item

How to cite:

Harty, Julian Mark Alistair (2020). Improving App Quality Despite Flawed Mobile Analytics. In: 7th IEEE/ACM International Conference on Mobile Software Engineering and Systems 2020, 13-15 Jul 2020, Seoul, South Korea, ACM.

For guidance on citations see [FAQs](#).

© 2020 The Authors



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.1145/3387905.3388603>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk

Improving App Quality Despite Flawed Mobile Analytics

Julian Harty
The Open University
Milton Keynes, U.K.
julian.harty@open.ac.uk



Figure 1: Improvements in the crash rate for the Pocket Code Android app

ABSTRACT

Analytics can help improve the quality of software; the improvements are affected by the fidelity of the analytics. The impact of poor fidelity may vary depending on the type of data being collected, for example, for crashes low fidelity may be sufficient.

The mobile ecosystem includes a platform where apps run and an app store that intermediates between developers and users. Google's Android ecosystem provides all the developers with analytics about various qualities of their app through a service called Android Vitals that automatically collects data on how their app is performing.

My research found ways to improve app quality through using mobile analytics, including Android Vitals. It also found fidelity flaws in several analytics tools provided by Google. They confirmed and validated some flaws and chose not to discuss others.

KEYWORDS

Android-vitals, Crashlytics, Firebase, Mobile-analytics

ACM Reference Format:

Julian Harty. 2020. Improving App Quality Despite Flawed Mobile Analytics. In *IEEE/ACM 7th International Conference on Mobile Software Engineering and Systems (MOBILESoft '20)*, October 5–6, 2020, Seoul, Republic of Korea. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3387905.3388603>

1 INTRODUCTION

Development teams want users to use their apps in order to achieve various goals such as revenue growth, popularity, etc. They would like their apps to be of high quality both for their own satisfaction and to encourage users to use their apps more.

Inherently developers construct models of their software in order to design, implement and test their apps. However, no model survives unscathed on contact with reality (paraphrasing "*no plan survives contact with the enemy*" [14]).

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

MOBILESoft '20, October 5–6, 2020, Seoul, Republic of Korea

© 2020 Copyright held by the owner/author(s).

ACM ISBN 978-1-4503-7959-5/20/05.

<https://doi.org/10.1145/3387905.3388603>

As an example, the Catdroid project includes over 1,500 hand-crafted automated tests intended to test almost every eventuality [13] and is developed using clean code and a myriad of additional approaches intended to deliver excellent code [7, 16]. Yet, in-use, the crash rate averaged 3.91%, nearly four times the bad behaviour threshold of 1.09% Google considers excessive [3]; and the app was in the bottom 7% of education apps according to Android Vitals [2]. Reality trumped the model.

Software Analytics has been established for at least a decade, for instance through the work of Buse and Zimmermann [5, 6]. The value of applying analytics to improve software's quality and fitness-for-purpose has also been established, e.g. by Microsoft where usage analytics were collected for 48,000 internal users of the Lync desktop application [17].

Mobile app ecosystems materially affect software development practices [1] by acting as an intermediary and a conduit between developers and end users. The relevance and importance of mining feedback for mobile apps is well established, e.g. understanding why users provide 1 and 2 star ratings [8]. Development teams can use feedback to improve the fidelity of their models of their software. Among various feedback channels, user feedback, i.e. ratings and reviews, seems to be well studied [8, 18, 19].

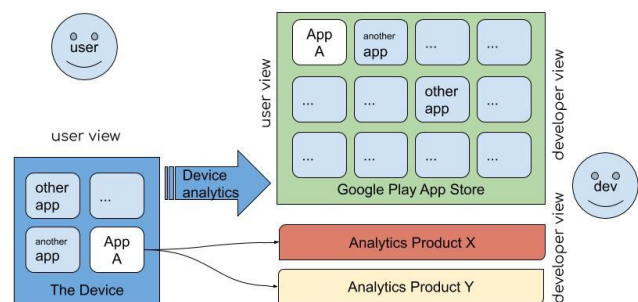


Figure 2: Data Sources and Views

My research focuses on automated feedback gathered using analytics by the platform, using Google's Android Vitals analytics service; and within an app using analytics libraries, e.g. Crashlytics and Firebase, that developers optionally include in their mobile app [4]. Figure 2 provides a model of these two forms of feedback:

essentially digital data is collected either by an app or by the platform, forwarded to servers for analysis, and then various analytics reports are made available to authorised team members.

2 APPROACH

We used mixed methods during our research aiming to complement hands-on work with interviews with developers of business critical apps [10]. As the analytics is restricted to authorised users and as it is only generated for actively used applications we collaborated with various development teams who provided access to their app's analytics data. The research involved working with several mature open-source projects with a combined user-base of 400,000. In each case one Android app was selected with the highest crash rate as measured by Android Vitals. The reports and data from Android Vitals were used on an ongoing basis to identify crashes and other stability issues. We raised bugs in the respective bug tracking systems for the most common issues. These were triaged by the development teams who fixed issues and released newer versions of both the selected app and their other apps.

To record and make the reports and data available we developed and opensourced Vitals Scraper¹ and to correct some flaws in the reporting we also created Android Stability Analysis².

3 RESULTS

For the Kiwix application, the crash rate decreased from 4.05% to 0.39% while the sibling apps continued to have a similar crash rate for a 4 month period. The sibling apps were then updated based on the improved code base and the reported crash rates have reduced by at least 50% within a month. For Pocket Code, the crash rate reduced from 3.91% to 1.07% Note: the crash rate of the sibling app Pocket Paint also decreased during the experiment, from 1.66% to 0.82%, as the development team chose to fix a crash that adversely affected many users.³). [12].

Aspects of the research were published at MobileSoft 2019 [9], WAMA 2019 [12], and in a jointly authored book in 2015/16 [11]. Extracts of Android Vitals data and reports have been made available to the research community. Various flaws were found in Android Vitals and Fabric Crashlytics, two of Google's key analytics tools. The flaws include differences in the outputs in of over 10:1 in the crash rates they calculate. The flaws were reported to the relevant Google development team in 2019-2020 who accepted the bug reports and requested a comprehensive report so they could address the relevant issues. While the Google engineering team acknowledge the differences, they are defensive about the reasons why. What if they have similar flaws in their payment calculations in the same app store, which handled an estimated gross revenue of 29.3 Billion USD in 2019⁴? Similar developers work on both.

Independent development teams of a variety of Android apps (including Moonpig[12], LocalHalo, and Moodspace [12]) confirm they actively use analytics to monitor the quality of their apps and fix crashes reported in these mobile analytics tools. Trello's Android team stress the importance of applying a similar approach [15];

4 CONCLUSION AND FUTURE WORK

Our research indicates developers can use mobile analytics to improve the reliability and performance of their mobile apps. The default Android Vitals analytics service provides adequate sources of information on crashes and ANRs and confirms the effects of fixes in newer releases of the respective apps. In-app analytics libraries provide finer-grained lower-latency feedback and developers tend to prefer these data sources to using Android Vitals.

Each of the tools we evaluated has fidelity flaws, the effect varies depending on the category of the data. Nonetheless, the developers improved the crash rate of their apps, by between $\frac{1}{3}$ and $\frac{1}{10}$, they also independently continue to apply the techniques I proposed. The engineering team at Google for Android Vitals follows our work. We will evaluate whether adding in-app analytics events, e.g. using Firebase, to apps improves their development and testing.

REFERENCES

- [1] Afnan AlSubaihini, Federica Sarro, Sue Black, Licia Capra, and Mark Harman. 2019. App store effects on software engineering practices. *IEEE Transactions on Software Engineering* 50, 8 (2019), 1–19.
- [2] Android Developers. 2020. Android vitals. <https://developer.android.com/topic/performance/vitals>
- [3] Android Developers. 2020. *Crashes - Android Developers*. Google. <https://developer.android.com/topic/performance/vitals/crash>
- [4] AppBrain. 2020. Android analytics libraries. <https://www.appbrain.com/stats/libraries/tag/analytics/android-analytics-libraries>
- [5] Raymond PL Buse and Thomas Zimmermann. 2010. Analytics for software development. In *Proceedings of the FSE/SDP workshop on Future of software engineering research*. ACM, ACM, Santa Fe, New Mexico, USA, 77–80.
- [6] Raymond PL Buse and Thomas Zimmermann. 2012. Information needs for software development analytics. In *Proceedings of the 34th international conference on software engineering*. IEEE Press, IEEE, Zurich, Switzerland, 987–996.
- [7] Catrobat Project Team. 2019. *Developer's website for the Catrobat project*. Catrobat Project. <https://developer.catrobat.org/>
- [8] Bin Fu, Jialiu Lin, Lei Li, Christos Faloutsos, Jason Hong, and Norman Sadeh. 2013. Why people hate your app: Making sense of user feedback in a mobile app store. In *Proceedings of the 19th ACM SIGKDD international conference on Knowledge discovery and data mining*. ACM, ACM, Chicago, Illinois, USA, 1276–1284.
- [9] Julian Harty. 2019. Google Play Console: Insightful Development using Android Vitals and Pre-Launch Reports. In *MOBILESoft 2019*. IEEE, IEEE, Montreal, QC, Canada, 62 – 65.
- [10] Julian Harty. 2020. How Can Software Testing be Improved by Analytics to Deliver Better Apps?. In *2020 13th IEEE Conference on Software Testing, Validation and Verification (ICST)*. IEEE, Porto, Portugal.
- [11] J. Harty and A. Aymer. 2015. *The Mobile Analytics Playbook: A Practical Guide to Better Testing*. Hewlett Packard Enterprise. 161 pages.
- [12] Julian Harty and Matthias Müller. 2019. Better Android Apps Using Android Vitals. In *WAMA 2019*. ACM, ACM, Tallinn, Estonia, 26 – 32.
- [13] Thomas Hirsch, Christian Schindler, Matthias Müller, Thomas Schranz, and Wolfgang Slany. 2019. An Approach to Test Classification in Big Android Applications. In *2019 IEEE 19th International Conference on Software Quality, Reliability and Security Companion (QRS-C)*. IEEE, 300–308.
- [14] Daniel J Hughes. 1995. *Moltke on the art of war: Selected writings*. Random House Digital, Inc., USA.
- [15] Dan Lew. 2018. *How to Release a Buggy App (And Live to Tell the Tale)*. <https://tech.trello.com/how-to-release-a-buggy-app-and-live-to-tell-the-story/>
- [16] Kirshan Kumar Luhana, Christian Schindler, and Wolfgang Slany. 2018. Streamlining mobile app deployment with Jenkins and Fastlane in the case of Catrobat's pocket code. In *2018 IEEE International Conference on Innovative Research and Development (ICIRD)*. IEEE, 1–6.
- [17] Robert Musson, Jacqueline Richards, Danyel Fisher, Christian Bird, Brian Bussone, and Sandipan Ganguly. 2013. Leveraging the crowd: How 48,000 users helped improve lync performance. *IEEE software* 30, 4 (2013), 38–45.
- [18] Sebastiano Panichella, Andrea Di Sorbo, Emitza Guzman, Corrado A Visaggio, Gerardo Canfora, and Harald C Gall. 2015. How can I improve my app? classifying user reviews for software maintenance and evolution. In *2015 IEEE international conference on software maintenance and evolution (ICSME)*. IEEE, 281–290.
- [19] Lorenzo Villarreal, Gabriele Bavota, Barbara Russo, Rocco Oliveto, and Massimiliano Di Penta. 2016. Release planning of mobile apps based on user reviews. In *2016 IEEE/ACM 38th International Conference on Software Engineering (ICSE)*. IEEE, 14–24.

¹<https://github.com/commercetest/vitals-scraper>

²<https://github.com/commercetest/android-stability-analysis>

³Release <https://github.com/Catrobat/Paintroid/releases/tag/v2.4.1>

⁴<https://sensortower.com/blog/app-revenue-and-downloads-2019>